MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

BER2094 – ENVIRONMENTAL & RESOURCE ECONOMICS

(All Sections/Groups)

24 OCTOBER 2019
9.00 am - 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE (5)** pages including cover page, with Section A and B.
2. Section A consists of **ONE (1)** Case Study. Section B consists of **THREE (3)** Structured Questions.
3. Attempt **ALL** questions.
4. Please write all the answers in the answer booklet provided.
5. The marks distribution for each question is given. Total mark is 100.

SECTION A: CASE STUDY (40 marks)

Climate 101: Ozone Depletion

The ozone layer helps to protect life from harmful ultraviolet radiation. Find out what caused the ozone hole, and how the 1989 Montreal Protocol sought to put an end to ozone depletion.

Over the past 30 years humans have made progress in stopping damage to the ozone layer by curbing the use of certain chemicals. But more remains to be done to protect and restore the atmospheric shield that sits in the stratosphere about 9 to 18 miles (15 to 30 kilometers) above the Earth's surface.

Atmospheric ozone absorbs ultraviolet (UV) radiation from the sun, particularly harmful UVB-type rays. Exposure to UVB radiation is linked with increased risk of skin cancer and cataracts, as well as damage to plants and marine ecosystems. Atmospheric ozone is sometimes labeled as the "good" ozone, because of its protective role, and shouldn't be confused with tropospheric, or ground-level, "bad" ozone, a key component of air pollution that is linked with respiratory disease.

Ozone (O_3) is a highly reactive gas whose molecules are comprised of three oxygen atoms. Its concentration in the atmosphere naturally fluctuates depending on seasons and latitudes, but it generally was stable when global measurements began in 1957. Groundbreaking research in the 1970s and 1980s revealed signs of trouble.

Ozone threats and 'the hole'

In 1974, Mario Molina and Sherwood Rowland, two chemists at the University of California, Irvine, published an article in *Nature* detailing threats to the ozone layer from chlorofluorocarbon (CFC) gases. At the time, CFCs were commonly used in aerosol sprays and as coolants in many refrigerators. As they reach the stratosphere, the sun's UV rays break CFCs down into substances that include chlorine.

The groundbreaking research—for which they were awarded the 1995 Nobel Prize in chemistry—concluded that the atmosphere had a "finite capacity for absorbing chlorine" atoms in the stratosphere.

One atom of chlorine can destroy more than 100,000 ozone molecules, according to the U.S. Environmental Protection Agency, eradicating ozone much more quickly than it can be replaced.

Molina and Rowland's work received striking validation in 1985, when a team of English scientists found a hole in the ozone layer over Antarctica that was later linked to CFCs. The "hole" is actually an area of the stratosphere with extremely low concentrations of ozone that reoccurs every year at the beginning of the Southern Hemisphere spring (August to October). Spring brings sunlight, which releases chlorine into the stratospheric clouds.

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The ozone layer's status today

Recognition of the harmful effects of CFCs and other ozone-depleting substances led to the Montreal Protocol on Substances That Deplete the Ozone Layer in 1987, a landmark agreement to phase out those substances that has been ratified by all 197 UN member countries. Without the pact, the U.S. would have seen an additional 280 million cases of skin cancer, 1.5 million skin cancer deaths, and 45 million cataracts—and the world would be at least 25 percent hotter.

More than 30 years after the Montreal Protocol, NASA scientists documented the first direct proof that Antarctic ozone is recovering because of the CFC phase-down: Ozone depletion in the region has declined 20 percent since 2005. And at the end of 2018, the United Nations confirmed in a scientific assessment that the ozone layer is recovering, projecting that it would heal completely in the (non-polar) Northern Hemisphere by the 2030s, followed by the Southern Hemisphere in the 2050s and polar regions by 2060.

Monitoring of the ozone layer continues, and it's finding that the recovery may not be as straightforward as hoped. A study in early 2018 found that ozone in the lower stratosphere unexpectedly and inexplicably has dropped since 1998, while another pointed to possible ongoing violations of the Montreal pact.

The world is not yet in the clear when it comes to harmful gases from coolants. Some hydrochlorofluorocarbons (HCFCs), transitional substitutes that are less damaging but still harmful to ozone, are still in use. Developing countries need funding from the Montreal Protocol's Multilateral Fund to eliminate the most widely used of these, the refrigerant R-22. The next generation of coolants, hydrofluorocarbons (HFCs), do not deplete ozone, but they are powerful greenhouse gases that trap heat, contributing to climate change.

Though HFCs represent a small fraction of emissions compared with carbon dioxide and other greenhouse gases, their planet-warming effect prompted an addition to the Montreal Protocol, the Kigali Amendment, in 2016. The amendment, which came into force in January 2019, aims to slash the use of HFCs by more than 80 percent over the next three decades. In the meantime, companies and scientists are working on climate-friendly alternatives, including new coolants and technologies that reduce or eliminate dependence on chemicals.

Source: Christina Nunez, National Geographic, April 18, 2019.
https://www.nationalgeographic.com/environment/global-warming/ozone-depletion/

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Based on the above article, answer the following questions:

a) Describe Ozone (O_3). (2 marks)

b) Indicate any **TWO (2)** primary causes of ozone depletion. (4 marks)

c) Give any **TWO (2)** health impacts of exposure to UVB radiation. (4 marks)

d) Examine Montreal Protocol 1987 and its objectives. (6 marks)

e) Summaries NASA's report on the achievements of the Montreal Protocol, after more than 30 years of implementation. (3 marks)

f) *"A study in early 2018 found that ozone in the lower stratosphere unexpectedly and inexplicably has dropped since 1998."*
Based on the article, examine the potential reasons for the above problem. (3 marks)

g) *Some hydrochlorofluorocarbons (HCFCs), transitional substitutes that are less damaging but still harmful to ozone, are still in use.*
As an environmental economist, illustrate graphically how an excise tax model could phase out HCFCs. Explain. (9 marks)

h) Besides excise tax, suggest another market approach that might be suitable to phase out such chemicals. Explain in detail with an appropriate example or diagram. (9 marks)

SECTION B: STRUCTURED QUESTIONS (60 marks)

QUESTION 1 (20 MARKS)

a) The release of wastewater from drains or sewers includes human wastes, soaps, and detergents caused **TWO (2)** serious water pollution. Indicate and explain. (5 marks)

b) Describe municipal solid waste. Explain any **TWO (2)** risks of municipal solid waste. (9 marks)

c) Discuss any **TWO (2)** factors that make oil cartelization possible. (6 marks)

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QUESTION 2 (20 MARKS)

a) Evaluate an industrial ecosystem through any **TWO (2)** advantages and **TWO (2)** disadvantages. (8 marks)

b) Analyze any **FOUR (4)** environmental effects of illegal logging to the forests in Malaysia. (12 marks)

QUESTION 3 (20 MARKS)

a) Two petrochemicals companies in Malaysia, Petronas Chemicals (P) and BASF Malaysia (B) were faced with the following Marginal Abatement Costs (MAC) for Olefins.

$$MAC_P = 1.2A_P \qquad MAC_B = 1.8A_B$$

A_P represents the quantity of abatement for Petronas Chemicals and A_B represents the quantity of abatement for BASF Malaysia. In the aggregate, the two companies do not hold enough Olefins allowances to cover their production activity and must abate a combined level of 20 units. Should each firm abate 10 units each? Economically debate your answer with MAC justification. Support your answer with calculation. (10 marks)

b) Formosa Plastics (a plastic manufacturing company) is releasing benzene chemicals into the water, and these emissions are associated with the development of leukemia for those who drink the contaminated water. Economists have estimated the following marginal costs and benefits for the plastic market, where Q is monthly output in thousands of pounds and P is price per pound.

$$MSB = 500 - 0.4Q;\ MSC = 20 + 0.4Q;\ MEB = 0;\ MEC = 0.2Q$$

i) Calculate the price (Pc) and quantity (Qc) in the competitive equilibrium. (6 marks)

ii) Estimate the price (Pe) and quantity (Qe) in the efficient equilibrium. (4 marks)

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